What Is Claimed Is:

1. An optical properties measurement method in which optical properties of a projection optical system that projects a pattern on a first surface onto a second surface is measured, said measurement method comprising:

a first step in which a rectangular shaped first area in general made up of a plurality of divided areas arranged in a matrix shape is formed on an object, by a measurement pattern arranged on said first surface being sequentially transferred onto said object arranged on said second surface side of said projection optical system while at least one exposure condition is changed;

a second step in which an overexposed second area is formed in an area on said object that is at least part of the periphery of said first area;

a third step in which a formed state of an image of said measurement pattern in a plurality of divided areas that are at least part of said plurality of divided areas making up said first area is detected; and

a fourth step in which optical properties of said projection optical system are obtained, based on results of said detection.

2. The optical properties measurement method of Claim 1 wherein

said second step is performed prior to said first step.

3. The optical properties measurement method of Claim 1 wherein

said second area is at least part of a rectangular frame shaped area that encloses said first area, slightly larger than said first area.

4. The optical properties measurement method of Claim 1 wherein

in said second step, said second area is formed by transferring a predetermined pattern arranged on said first surface onto said object arranged on said second surface side of said projection optical system.

5. The optical properties measurement method of Claim 4 wherein

said predetermined pattern is a rectangular shaped pattern in general, and

in said second step, said rectangular shaped pattern in general arranged on said first surface is transferred onto said object arranged on said second surface side of said projection optical system by a scanning exposure method.

6. The optical properties measurement method of Claim 4 wherein

said predetermined pattern is a rectangular shaped pattern in general, and

in said second step, said rectangular shaped

pattern in general arranged on said first surface is sequentially transferred onto said object arranged on said second surface side of said projection optical system.

7. The optical properties measurement method of Claim 1 wherein

in said second step, said measurement pattern arranged on said first surface is sequentially transferred onto said object arranged on said second surface side of said projection optical system with an overexposed exposure amount, so as to form said second area.

8. The optical properties measurement method of Claim 1 wherein

in said third step, each position is calculated for said plurality of divided areas making up said first area, with part of said second area as datums.

9. The optical properties measurement method of Claim 1 wherein

in said third step, said formed state of an image in a plurality of divided areas that are at least part of said plurality of divided areas making up said first area is detected by a template matching method, based on imaging data corresponding to said plurality of divided areas that make up said first area and to said second

area.

10. The optical properties measurement method of Claim 1 wherein

in said third step, said formed state of an image in a plurality of divided areas that are at least part of said plurality of divided areas making up said first area is detected with a representative value related to pixel data of each of said divided areas obtained by imaging serving as a judgment value.

11. The optical properties measurement method of Claim 10 wherein

said representative value is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of said pixel data.

12. The optical properties measurement method of Claim 10 wherein

said representative value is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of a pixel value within a designated range in each divided area.

13. The optical properties measurement method of Claim 10 wherein

on detecting said formed state of said image, binarization is performed comparing said representative

value for each of said divided areas to a predetermined threshold value.

14. The optical properties measurement method of Claim 1 wherein

said exposure condition includes at least one of a position of said object in an optical axis direction of said projection optical system and an energy amount of an energy beam irradiated on said object.

15. The optical properties measurement method of Claim 1 wherein

on transferring said measurement pattern, said measurement pattern is sequentially transferred onto said object while a position of said object in an optical axis direction of said projection optical system and an energy amount of an energy beam irradiated on said object are changed, respectively,

on detecting said formed state of said image, image availability of said measurement pattern in said at least part of said plurality of divided areas on said object is detected, and

on obtaining said optical properties, the best focus position is decided from a correlation between an energy amount of said energy beam and a position of said object in said optical axis direction of said projection optical system that corresponds to said plurality of divided areas where said image is detected.

16. An optical properties measurement method in which optical properties of a projection optical system that projects a pattern on a first surface onto a second surface is measured, said measurement method comprising:

a first step in which a measurement pattern including a multibar pattern arranged on said first surface is sequentially transferred onto an object arranged on said second surface side of said projection optical system while at least one exposure condition is changed, and a predetermined area made up of a plurality of adjacent divided areas is formed where said multibar pattern transferred on each divided area and its adjacent pattern are spaced apart at a distance greater than distance L, which keeps contrast of an image of said multibar pattern from being affected by said adjacent pattern;

a second step in which a formed state of an image in a plurality of divided areas that are at least part of said plurality of divided areas making up said predetermined area is detected; and

a third step in which optical properties of said projection optical system are obtained, based on results of said detection.

17. The optical properties measurement method of Claim 16 wherein

in said second step, said formed state of an image

is detected by an image processing method.

18. The optical properties measurement method of Claim 16 wherein

when resolution of an imaging device that images each of said divided areas is expressed as R_f, contrast of said multipattern image is expressed as C_f, process factor determined by process is expressed as P_f, and detection wavelength of said imaging device is expressed as λ_f, then said distance L is expressed as a function $L=f(C_f, R_f, P_f, \text{and } \lambda_f)$.

19. The optical properties measurement method of Claim 16 wherein

said predetermined area is a rectangular shape in general made up of a plurality of divided areas arranged in a matrix on said object.

20. The optical properties measurement method of Claim 19 wherein

in said second step, a rectangular outer frame made up of an outline of the outer periphery of said predetermined area is detected based on imaging data corresponding to said predetermined area, and with said outer frame as datums, each position of a plurality of divided areas that make up said predetermined area is calculated.

21. The optical properties measurement method of Claim 16 wherein

in said first step, as a part of said exposure condition, an energy amount of an energy beam irradiated on said object is changed so that a plurality of specific divided areas that are at least a part of a plurality of divided areas located on the outermost portion within said predetermined area becomes an overexposed area.

22. The optical properties measurement method of Claim 16 wherein

in said second step, said formed state of an image in a plurality of divided areas that are at least part of said plurality of divided areas making up said predetermined area is detected by a template matching method, based on imaging data corresponding to said plurality of divided areas making up said predetermined area.

23. The optical properties measurement method of Claim 16 wherein

in said second step, said formed state of an image in a plurality of divided areas that are at least part of said plurality of divided areas making up said predetermined area is detected with a representative value related to pixel data of each of said divided areas obtained by imaging serving as a judgment value.

24. The optical properties measurement method of Claim 23 wherein

said representative value is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of said pixel data.

25. The optical properties measurement method of Claim 23 wherein

said representative value is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of a pixel value within a designated range in each divided area.

26. The optical properties measurement method of Claim 16 wherein

said exposure condition includes at least one of a position of said object in an optical axis direction of said projection optical system and an energy amount of an energy beam irradiated on said object.

27. The optical properties measurement method of Claim 16 wherein

on transferring said measurement pattern, said measurement pattern is sequentially transferred onto said object while a position of said object in an optical axis direction of said projection optical system and an energy amount of an energy beam irradiated on said object are changed, respectively,

on detecting said formed state of said image, image availability of said measurement pattern in said at least part of said plurality of divided areas on said object is detected, and

on obtaining said optical properties, the best focus position is decided from a correlation between an energy amount of said energy beam and a position of said object in said optical axis direction of said projection optical system that corresponds to said plurality of divided areas where said image is detected.

28. An optical properties measurement method in which optical properties of a projection optical system that projects a pattern on a first surface onto a second surface is measured, said measurement method comprising:

a first step in which a rectangular shaped predetermined area in general made up of a plurality of divided areas arranged in a matrix shape is formed on an object, by arranging a measurement pattern formed on a light transmitting section on said first surface and sequentially moving said object arranged on said second surface side of said projection optical system at a step pitch whose distance corresponds to the size equal to said light transmitting section and under, while at least one exposure condition is changed;

a second step in which a formed state of an image in a plurality of divided areas that are at least part of said plurality of divided areas making up said

predetermined area is detected; and

a third step in which optical properties of said projection optical system are obtained, based on results of said detection.

29. The optical properties measurement method of Claim 28 wherein

in said second step, said formed state of said image is detected by an image processing method.

30. The optical properties measurement method of Claim 28 wherein

said step pitch is set so that projection areas of said light transmitting section are one of being substantially in contact and being overlapped on said object.

31. The optical properties measurement method of Claim 30 wherein

on said object, a photosensitive layer is made of a positive type photoresist on its surface, said image is formed on said object after going through a development process after said measurement pattern is transferred, and said step pitch is set so that a photosensitive layer between adjacent images on said object is removed by said development process.

32. The optical properties measurement method of

Claim 28 wherein

on said object, a photosensitive layer is made of a positive type photoresist on its surface, said image is formed on said object after going through a development process after said measurement pattern is transferred, and said step pitch is set so that a photosensitive layer between adjacent images on said object is removed by said development process.

33. The optical properties measurement method of Claim 28 wherein

in said first step, as a part of said exposure condition, an energy amount of an energy beam irradiated on said object is changed so that a plurality of specific divided areas that are at least a part of a plurality of divided areas located on the outermost portion within said predetermined area becomes an overexposed area.

34. The optical properties measurement method of Claim 28 wherein said second step includes:

an outer frame detection step in which a rectangular outer frame made up of an outline of the outer periphery of said predetermined area is detected based on imaging data corresponding to said predetermined area; and

a calculation step in which each position of a plurality of divided areas that make up said predetermined area is calculated with said outer frame as

datums.

35. The optical properties measurement method of Claim 34 wherein

in said outer frame detection step, said outer frame detection is performed based on at least eight points that are obtained, which are at least two point obtained on a first side to a fourth side that make up said rectangular outer frame that form an outline of the outer periphery of said predetermined area.

36. The optical properties measurement method of Claim 34 wherein

in said calculation step, each position of said plurality of divided areas that make up said predetermined area is calculated by using known arrangement information of a divided area and equally dividing an inner area of said outer frame that has been detected.

37. The optical properties measurement method of Claim 34 wherein said outer frame detection step includes:

a rough position detecting step in which rough position detection is performed on at least one side of a first side to a fourth side that make up said rectangular outer frame that form an outline of the outer periphery of said predetermined area; and

a detail position detecting step in which the position of said first side to said fourth side is detected using detection results of said rough position detection performed on at least one side calculated in said rough position detecting step.

38. The optical properties measurement method of Claim 37 wherein

in said rough position detecting step, border detection is performed using information of a pixel column in a first direction that passes near an image center of said predetermined area, and a rough position of said first side and said second side that are respectively located on one end and the other end in said first direction of said predetermined area and extend in a second direction perpendicular to said first direction is obtained, and

in said detail position detecting step

border detection is performed, using a pixel column in said second direction that passes through a position a predetermined distance closer to said second side than said obtained rough position of said first side and also a pixel column in said second direction that passes through a position a predetermined distance closer to said first side than said obtained rough position of said second side, and said third side and said fourth side that are respectively located on one end and the other

end in said second direction of said predetermined area extending in said first direction and two points each on both said third side and said fourth side are obtained,

border detection is performed, using a pixel column in said first direction that passes through a position a predetermined distance closer to said fourth side than said obtained third side and also a pixel column in said first direction that passes through a position a predetermined distance closer to said third side than said obtained fourth side, and two points each on both said third side and said fourth side of said predetermined area are obtained,

four corners of said predetermined area, which is a rectangular shaped area, are obtained as intersecting points of four straight lines that are determined based on two points each being located on said first side to said fourth side, and

based on said four corners that are obtained, rectangle approximation is performed by a least squares method to calculate said rectangular outer frame of said predetermined area including rotation.

39. The optical properties measurement method of Claim 38 wherein

on said border detection, a detection range of a border where error detection may easily occur is narrowed down, using detection information of a border where error

detection is difficult to occur.

40. The optical properties measurement method of Claim 38 wherein

on said border detection, intersecting points of a signal waveform formed based on pixel values of each of said pixel columns and a predetermined threshold value t are obtained, and then a local maximal value and a local minimal value close to each intersecting point are obtained,

an average value of said local maximal value and said local minimal value that have been obtained is expressed as a new threshold value t', and

a position where said signal waveform crosses said new threshold value t' in between said local maximal value and said local minimal value is obtained, which is determined as a border position.

41. The optical properties measurement method of Claim 40 wherein

said threshold value t is set by

obtaining the number of intersecting points of a threshold value and a signal waveform formed of pixel values of linear pixel columns extracted for said border detection while said threshold value is changed within a predetermined fluctuation range, deciding a threshold value to be a temporary threshold value when said number of intersecting

points obtained matches a target number of intersecting points determined according to said measurement pattern, obtaining a threshold range that includes said temporary threshold value and said number of intersecting points matches said target number of intersecting points, and deciding the center of said threshold range center as said threshold value t.

42. The optical properties measurement method of Claim 41 wherein

said fluctuation range is set based on an average and a standard deviation of said pixel values of linear pixel columns extracted for said border detection.

43. The optical properties measurement method of Claim 28 wherein

in said second step, said formed state of an image in a plurality of divided areas that are at least part of said plurality of divided areas making up said first area is detected by a template matching method, based on imaging data corresponding to said predetermined area.

44. The optical properties measurement method of Claim 28 wherein

in said second step, said formed state of an image in a plurality of divided areas that are at least part of said plurality of divided areas making up said

predetermined area is detected with a representative value related to pixel data of each of said divided areas obtained by imaging serving as a judgment value.

45. The optical properties measurement method of Claim 44 wherein

said representative value is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of said pixel data.

46. The optical properties measurement method of Claim 44 wherein

said representative value is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of a pixel value within a designated range in each divided area.

47. The optical properties measurement method of Claim 46 wherein

said designated range is a reduced area where each of said divided areas is reduced at a reduction rate decided according to a designed positional relationship between an image of said measurement pattern and said divided area.

48. The optical properties measurement method of Claim 28 wherein

said exposure condition includes at least one of a

position of said object in an optical axis direction of said projection optical system and an energy amount of an energy beam irradiated on said object.

49. The optical properties measurement method of Claim 28 wherein

in said first step, said measurement pattern is sequentially transferred onto said object while a position of said object in an optical axis direction of said projection optical system and an energy amount of an energy beam irradiated on said object are changed, respectively,

in said second step, image availability of said measurement pattern in said at least part of said plurality of divided areas on said object is detected, and

in said third step, the best focus position is decided from a correlation between an energy amount of said energy beam and a position of said object in said optical axis direction of said projection optical system that corresponds to said plurality of divided areas where said image is detected.

50. An optical properties measurement method in which optical properties of a projection optical system that projects a pattern on a first surface onto a second surface is measured, said measurement method comprising:

a first step in which a measurement pattern

arranged on said first surface is sequentially transferred onto a plurality of areas on an object arranged on said second surface side of said projection optical system while at least one exposure condition is changed;

a second step in which said measurement pattern transferred with different exposure conditions on said plurality of areas is imaged, imaging data for each area consisting of a plurality of pixel data is obtained, and a formed state of an image of said measurement pattern is detected in a plurality of areas that are at least part of said plurality of areas, using a representative value related to pixel data for each area; and

a third step in which optical properties of said projection optical system are obtained, based on results of said detection.

51. The optical properties measurement method of Claim 50 wherein

in said second step, said formed state of an image of said measurement pattern is detected in a plurality of areas that are at least part of said plurality of areas by setting a representative value that is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of all pixel data for each area, and comparing said representative value with a predetermined threshold value.

52. The optical properties measurement method of Claim 50 wherein

in said second step, said formed state of an image of said measurement pattern is detected in a plurality of areas that are at least part of said plurality of areas by setting a representative value that is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of partial pixel data for each area, and comparing said representative value with a predetermined threshold value.

53. The optical properties measurement method of Claim 52 wherein

said partial pixel data is pixel data within a designated range within said each area, and said representative value is one of an additional value, a differential sum, a dispersion, and a standard deviation of said pixel data.

54. The optical properties measurement method of Claim 53 wherein

said designated range is a partial area in said each area, which is determined according to an arrangement of said measurement pattern within said each area.

55. The optical properties measurement method of Claim 50 wherein

in said second step, said formed state of an image of said measurement pattern is detected for a plurality of different threshold values by comparing said threshold values with said representative value, and

in said third step, said optical properties are measured based on results of said detection obtained for each of said threshold values.

56. The optical properties measurement method of Claim 50 wherein

said second step includes:

a first detection step in which a first formed state of an image of said measurement pattern is detected by setting a representative value that is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of all pixel data for each area in a plurality of areas that are at least part of said plurality of areas, and comparing said representative value with a predetermined threshold value; and

a second detection step in which a second formed state of said image of said measurement pattern is detected by setting a representative value that is at least one of an additional value, a differential sum, a dispersion, and a standard deviation of partial pixel data for each area in a plurality of areas that are at least part of said plurality of areas, and comparing said

representative value with a predetermined threshold value, and

in said third step, optical properties of said projection optical system are obtained, based on results of detecting said first formed state and results of detecting said second formed state.

57. The optical properties measurement method of Claim 56 wherein

in said second step, said first formed state and said second formed state of an image of said measurement pattern are each detected for a plurality of different threshold values, by comparing said threshold values and said representative value for each threshold value, and

in said third step, optical properties of said projection optical system are obtained, based on results of detecting said first formed state and results of detecting said second formed state obtained for each of said threshold values.

58. The optical properties measurement method of Claim 50 wherein

said exposure condition includes at least one of a position of said object in an optical axis direction of said projection optical system and an energy amount of an energy beam irradiated on said object.

59. The optical properties measurement method of

Claim 50 wherein

in said first step, said measurement pattern is sequentially transferred onto a plurality of areas on said object while a position of said object in an optical axis direction of said projection optical system and an energy amount of an energy beam irradiated on said object are changed, respectively,

in said second step, said formed state of said image is detected for each position in said optical axis direction of said projection optical system, and

in said third step, the best focus position is decided from a correlation between an energy amount of said energy beam with which said image was detected and a position of said object in said optical axis direction of said projection optical system.

60. An exposure method in which an energy beam for exposure is irradiated on a mask, and a pattern formed on said mask is transferred onto an object via a projection optical system, said method comprising:

an adjustment step in which said projection optical system is adjusted taking into consideration optical properties that are measured using said optical properties measurement method of Claim 1; and

a transferring step in which said pattern formed on said mask is transferred onto said object via said projection optical system that has been adjusted.

61. A device manufacturing method including a lithographic process, wherein

in said lithographic process, exposure is performed using said exposure method of Claim 60.

62. An exposure method in which an energy beam for exposure is irradiated on a mask, and a pattern formed on said mask is transferred onto an object via a projection optical system, said method comprising:

an adjustment step in which said projection optical system is adjusted taking into consideration optical properties that are measured using said optical properties measurement method of Claim 16; and

a transferring step in which said pattern formed on said mask is transferred onto said object via said projection optical system that has been adjusted.

63. A device manufacturing method including a lithographic process, wherein

in said lithographic process, exposure is performed using said exposure method of Claim 62.

64. An exposure method in which an energy beam for exposure is irradiated on a mask, and a pattern formed on said mask is transferred onto an object via a projection optical system, said method comprising:

an adjustment step in which said projection optical system is adjusted taking into consideration optical

properties that are measured using said optical properties measurement method of Claim 28; and

a transferring step in which said pattern formed on said mask is transferred onto said object via said projection optical system that has been adjusted.

65. A device manufacturing method including a lithographic process, wherein

in said lithographic process, exposure is performed using said exposure method of Claim 64.

66. An exposure method in which an energy beam for exposure is irradiated on a mask, and a pattern formed on said mask is transferred onto an object via a projection optical system, said method comprising:

an adjustment step in which said projection optical system is adjusted taking into consideration optical properties that are measured using said optical properties measurement method of Claim 50; and

a transferring step in which said pattern formed on said mask is transferred onto said object via said projection optical system that has been adjusted.

67. A device manufacturing method including a lithographic process, wherein

in said lithographic process, exposure is performed using said exposure method of Claim 66.